Custom Problem #1: Quality Factor

Recall that the average energy stored in a damped harmonic oscillator decreases exponentially in time: $\overline{E} = \overline{E}_0 \exp(-\gamma t)$. The quality factor of the oscillator is defined as $Q = \omega_0 / \gamma$

(a) When the note "middle C" on the piano is struck, its energy of oscillation decreases to one half its initial value in about 1 second. The frequency of middle C is 256 Hz. What is the Q of the system?

(b) If the note an octave higher (512 Hz) takes the same time for its energy to decay, what is its Q?

(c) A damped harmonic oscillator, consisting of a mass $m = 0.1$ kg moving in a viscous liquid of damping coefficient b ($F_{viscous} = -bv$), and attached to a spring of spring constant $k = 0.9$ N/m, is observed as it performs damped oscillatory motion. Its average energy decays to $1/e$ of its initial value in 4 seconds. What is the Q of the oscillator? What is the value of b?